OLDMAN RIVER DAM

ECONOMIC ANALYSIS

JANUARY 1986

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Dear Dr. McManus:

It is a pleasure to transmit to you our 1986 report entitled: *Oldman River Dam: Economic Analysis*; a study which updates the basic regional and provincial benefit-cost estimates first calculated in 1978.

Our findings indicate that these particular benefit-cost ratios have declined somewhat during 1979-1985 but that they still exceed unity. From this economic perspective, therefore, we would still consider the Oldman River Dam a feasible public investment opportunity.

Thank you for this opportunity to review and revise our earlier analysis on this topic.

Respectfully submitted,

MARV ANDERSON AND ASSOCIATES LTD.

Dr. M. S. Anderson, P. Ag.

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EXECUTIVE SUMMARY

A comprehensive economic benefit-cost analysis of the presently proposed Oldman River Dam at the Three Rivers site was initially prepared for the Government of Alberta in 1978.[1]

The particularily pertinent benefit-cost ratios derived at that time were the following:

Total Regional Net Benefit-Cost Ratio = 2.2

Total Provincial Net Benefit-Cost Ratio = 3.1

These ratios strongly suggested that the proposed dam was an economically feasible public investment opportunity. But in early 1986, with current construction cost estimates and presently projected economic benefits to the region and province, are these benefit-cost ratios still valid? The principal objective of this study was to re-estimate these specific benefit-cost ratios in light of economic conditions in the mid-1980's.

Following the methodology of the *'78 Economic Study*, therefore, an up-dated discounted cash flow analysis was conducted using current cost and benefit projections and the following benefit-cost framework:

$$B/C = \frac{NDB + NIB}{TPC}$$

Where B/C = benefit-cost ratio
NDB = net direct benefits
NIB = net indirect benefits
TPC = total project costs

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[1]Marv Anderson & Associates, *Oldman River Basin Study, Phase II, Economic Analysis of Water Supply Alternatives*, Alberta Environment, Lethbridge, April 1978.

The basic empirical results generated in this manner were as follows:

Criteria	Minimum (-20%)	Best Estimate	Maximum (+20%)
Regional B/C Ratio	1.31	*1.64*	1.97
Provincial B/C Ratio	1.74	*2.17*	2.60

Thus we find that while the original (1978) regional benefit-cost ratio was expected to be a relatively high 2.2, the revised estimate is 1.64. And whereas the original benefit-cost ratio was 3.1, this is now 2.17.

This indicates that despite numerous changes in both anticipated costs and projected benefits during 1979-85 (in nominal dollars), the real change (ignoring inflation) was much less pronounced. Although these revised estimates do indicate that there was a real "cost-price squeeze" during 1979-85 (and hence a modest decline in the respective ratios) the net effect was not serious enough to jeopardize the economic feasibility of the proposed Oldman River Dam. The expected B/C ratios still exceed unity.

Using this decision-making criteria, therefore, the principal policy implication is the same as in 1978: the Oldman River Dam is (still) an economically feasible public investment opportunity.

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I. INTRODUCTION

A comprehensive economic benefit-cost analysis of the presently proposed Oldman River Dam at the Three Rivers site was initially prepared for the Government of Alberta in 1978.[1]

The particularly pertinent benefit-cost ratios derived at that time were the following:

Total Regional Net Benefit-Cost Ratio = 2.2

Total Provincial Net Benefit-Cost Ratio = 3.1

These ratios strongly suggested that the proposed dam was an economically feasible public investment opportunity.

But since 1978 construction cost estimates for the proposed Oldman River Dam have escalated and numerous other changes have occured which may have also affected the economic feasibility of the proposed project. In early 1986, therefore, are the original 1978 benefit-cost ratios still valid?

The principal objective of this study is to re-estimate these specific benefit-cost ratios in light of economic conditions in the mid-1980's.

The report following documents the results of this analysis.

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[1]Marv Anderson & Associates, *Oldman River Basin Study, Phase II, Economic Analysis of Water Supply Alternatives*, Alberta Environment, Lethbridge, April 1978.

II. METHODOLOGY

2.1 Introduction

The purpose of this section is to briefly outline the basic methodology and underlying assumptions utilized in the analysis which follows.

2.2 Evaluation Criteria

Similar to the *'78 Economic Study*, the basic methodology utilized is discounted cash flow analysis, a methodology which traces all the tangible incremental costs and benefits of a project over time, adjusts future dollars to the present (by using the inverse of an interest rate), and then compares the cumulative value of the projected benefit stream with the cumulative value of the anticipated cost stream. Thus:

$$B/C = \frac{\text{Sum of Discounted Tangible Incremental Benefits}}{\text{Sum of Discounted Tangible Incremental Costs}}$$

NPV = Sum of Discounted Tangible Incremental Benefits *minus* Sum of Discounted Tangible Incremental Costs

To be economically feasible, the Benefit-Cost Ratio (B/C) must exceed 1.0, and the Net Present Value (NPV) must be positive. In this analysis, both calculations will have the same policy implications.

This evaluation technique focuses exclusively on the *incremental* benefits and costs with project implementation. Thus, a "with" and "without" project approach is required:

	Benefits	Costs	Difference
With Project	R	C	I
Without Project	R'	C'	I'
Difference	R"	C"	I"

where R, C and I are gross revenue, costs and income respectively.

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The final analysis focuses on:

$$R'' - C'' = I - I' = I''$$

the *net* tangible (income) *difference* between having or not having the Oldman River Dam in place.

Moreover, this incremental difference is calculated such that it is generally consistent with the Gross Domestic Product (or net value-added) in the national income accounts. This measure is a close approximation to factor earnings, i.e., wages and salaries, profits and investment income, and the earnings to management. (Also see Appendix A.)

In general, this methodology follows Gittinger[1] and related documentation.

2.3 Related Parameters

In the above context, three underlying assumptions (or parameters) are also central: (1) general price levels, (2) discount (interest) rates, and (3) the time frame. Our basic parameters are the following:

Price Level:	Constant 1985 prices
Discount Rate:	5 percent/year
Time Frame:	50 years

To eliminate the problem of changes in the *general price level*, all prices in this analysis are expressed in terms of constant 1985 dollars. The actual prices selected reflect projected average real prices during the project period. The use of real 1985 dollars is consistent with the use of a real discount rate (see below).

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[1]Gittinger, J.P., *Economic Analysis of Agricultural Projects*, 2nd edition, John Hopkins University Press, Baltimore, 1982.

In addition, *relative* prices are assumed not to change over the project life. While it is acknowledged that changes in relative prices can and do occur (e.g., the price of oil during the last decade), quantifying these anticipated changes in any meaningful way is extremely difficult. (Also see Appendix A.)

Because benefits and costs do not all accrue immediately, future payments must be also discounted to their present value. The *discount rate* can be interpreted as the opportunity cost of capital or as a time preference for current as opposed to future consumption. An interest rate and a discount rate are mirror images of one another. In this manner, cash-flow analysis can ensure that capital and savings are at least as well used in the proposed project as in any other desirable "delayed benefit" project considered for investment.

To convert a future stream of benefits and costs to a present value, therefore a discount rate is used. The choice of the rate is very crucial to the economic feasibility of the project. Generally, for water resource projects, the higher the discount rate, the less attractive the project. This is due to the fact that the benefits accrue further off in the future than the costs and are discounted more heavily.

For the purposes of this report, a basic real discount rate of five percent/annum is employed. This is the same discount rate as that employed in the original *Oldman River Basin Study* of 1978. A more detailed discussion of discount rates is provided in other more recent reports by the same author.[1]

Finally, the significant *economic life* of a project is the time required such that 90 percent or more of the cumulative present value of the benefits and costs are obtained. The economic life of a project is critically affected by the discount rate employed. With a ten percent discount rate, the significant period is 24 years; with a discount rate of five percent, the

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[1]See especially: Marv Anderson & Assoc. Ltd., *Milk River Basin Studies: Socio-Economic Analysis of Water Supply Alternatives, Part II*, Alberta Environment, Edmonton, April 1981, Appendix D.

relevant period is about 50 years. For the purposes of this report, the life of the project is assumed to be 50 years, including the project construction period. This 50 year time frame was also considered appropriate in the original *Oldman River Basin Study* of 1978.

Utilizing this methodological framework, anticipated incremental costs and benefits which would be directly attributable to the Oldman River Dam are tabulated in Sections III-IV immediately following.

III. INVESTMENT PROPOSAL

3.1 Introduction

The purpose of this section is to quantify all anticipated costs directly associated with actual implementation of the proposed project, namely the Oldman River Dam. Accordingly, the costs which must be considered include: (1) capital and O & M costs for the dam itself, (2) incremental water delivery costs (capital and O & M), (3) incremental on-farm irrigation development costs (capital and O & M), (4) incremental on-farm production costs, and (5) the cost of flooding existing agricultural lands at the reservoir site. Each is considered in turn.

3.2 Oldman River Dam

The proposed Oldman River Dam at the Three Rivers site is now estimated to cost (in $ 1985) about $320 million. This total includes some expenditures for infrastructure (e.g., roads) and environmental *enhancement* which should, strictly speaking, be excluded from the calculations which follow.

The estimated cost in 1978 (in $ 1978) was $95-$115 million; about one-third of the currently projected total capital cost in $ 1985. These projected cost increases can largely be attributed to the general level of inflation in the economy during 1979-85 (about $75 million), subsequent design changes to the dam itself, and additional cost items which relate to the infrastructural and environmental enhancement now envisioned. (See above.)

Accordingly, and assuming a five-year construction period, annual expenditure levels would now be expected to be approximately as follows: ($ 1985)

Year 1	$75M
Year 2	$45M
Year 3	$60M
Year 4	$75M
Year 5	$65M
TOTAL	$320M

These are the estimates which are employed in Section V following.

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Subsequent annual operation and maintenance (Years 6-50) is estimated to amount to about $550,000 per annum, also expressed in $ 1985.

3.3 Water Delivery Costs

Where the additional water would be used for irrigated crop production in Southern Alberta can not be precisely predicted. It would, however, include a combination of the following: (1) existing Irrigation Districts, particularly the LNID and, to a lesser extent, the SMRID; (2) private pumping directly from the reservoir and the river downstream; (3) Peigan Indian Reserve #147; and (4) other private or District use. In some cases, existing systems (sunk costs) are adequate; in other cases new or improved water delivery systems would be required.

In this context, the *incremental* investment required for more and better water delivery systems to the farm gate is still difficult to quantify with any degree of accuracy.

For the purposes of this study, we anticipate that perhaps three-quarters of the new irrigated acreage would require additional capital expenditures to facilitate water delivery to the farm gate and, furthermore, to estimate these expenditures the following rate structure is considered appropriate:[1]

Distance from Water Source	Capital Cost $ 1985
Adjacent	nil
0-0.8 km	$128/acre
0.8-1.6 km	$268/acre

The estimate employed in the simulations which follow (Section V) is $150/acre, up to a maximum 173,050 acres. This amounts to about $26M in $ 1985.

[1]Alberta Agriculture/Project Planning Branch, *Irrigation Feasibility in the Willow Creek Basin*, Lethbridge, August 1985.

In addition, annual O & M for these additional facilities is expected to amount to perhaps $5/acre/year[1] or, say, $865,000/year at project maturity. This is analogous to an Irrigation District "water rate."

3.4 On-Farm Irrigation Costs

The additional capital expenditures required for irrigation equipment on farms are also difficult to estimate. But, for the purposes of this analysis, we expect that perhaps three-quarters of the new irrigated acreage would also require additional capital expenditures for on-farm irrigation facilities. This incremental capital cost is expected to average $450/acre, again up to a maximum 173,050 acres:[2] ($ 1985/acre)

Distance from Water Source	25' Lift	100' Lift
Adjacent	$452	$473
0.8 km	564	640
1.6 km	698	796
2.4 km	830	952

This would suggest that during Years 6-19 the additional capital requirement for on-farm irrigation facilities could reach $78M in $ 1985.

Related annual O & M costs, amounting to about $25/acre/year,[3] are incorporated into the annual cost-of-production estimates discussed immediately following.

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[1] *Ibid.*

[2] Costs for ½ mile center pivot on ¼ section. *Ibid.* Also see: MAA *Economic and Financial Analysis of Clear Lake Irrigation Development*, Alberta Environment, Edmonton, December 1984.

[3] Alberta Agriculture, *op. cit.*.

3.5 Incremental On-Farm Production Costs

Associated *incremental on-farm production costs* are calculated from estimated crop production costs for irrigation versus dryland, given the respective cropping patterns and cropping intensities. Estimates have been prepared for both the Lethbridge Northern Irrigation District (LNID) and the St. Mary River Irrigation District (SMRID) and are assumed to be representative of all areas which eventually secure water for irrigation purposes from the proposed Oldman River Dam. The respective annual production cost differences are estimated to be as follows: ($ 1985/acre)

	LNID	SMRID
Irrigation	166	189
Dryland	19	14
Difference	$147	$175

Per acre costs-of-production for irrigated crops include the O & M costs associated with on-farm irrigation facilities. (See above.)

For more details, consult Appendix A.

In the analysis which follows incremental on-farm production costs are subtracted directly from projected revenue changes to determine the incremental *net* value of farm output after the irrigation facilities are in place. (Section IV.)

3.6 Agricultural Losses at Reservoir Site

Despite the fact that estimated dam costs include the cost of land acquisition, for the purposes of this analysis expected annual production losses because agricultural land is lost to flooding are also included as an additional cost to the project. This is, in effect, a double counting of costs associated with lost agricultural productivity at the reservoir site and downward biases project feasibility. However, this procedure was followed in the original analysis in 1978 and is retained here for consistency purposes.

The land affected is as follows:

Cultivated	883 ac
Pasture	1,059 ac
Grazing	1,807 ac
Brush and Trees	807 ac
Non-Productive	950 ac
River	294 ac
TOTAL	5,800 ac

This is expected to result in a direct (farm) loss of about $134,000 per annum.[1] In turn,this would suggest a total regional and provincial loss of about $170,000/annum and $250,000/annum respectively.[2]

[1]Taken directly from the *'78 Economic Study*, inflated 78 percent to be consistent with Section IV following.

[2]Direct value-added loss x 1.27 and 1.868 respectively. The rationale for these "multipliers" can be found in Section IV following.

IV. PROJECTED BENEFITS

4.1 Introduction

The objective of this Section is to quantify the principal economic *benefits* anticipated with construction of the Oldman River Dam. In conjunction with the data tabulated in Section III, this will then set the stage for a direct comparison of the respective cost and revenue projections in Section V following.

Three potential benefits are considered: (1) incremental crop and livestock revenues; (2) local construction expenditures, and (3) spin-off (or secondary) income generated from (1) and (2) as this income circulates throughout the regional and provincial economy.

4.2 Incremental Crop-Livestock Revenues

4.2.1 Crops

Analogous to the calculations to derive incremental on-farm production costs (see Section 3.5), incremental crop revenue estimates have been generated by comparing crop revenues for irrigation versus dryland, given the respective cropping patterns and cropping intensities. Again, estimates have been prepared for both the LNID and SMRID and are considered representative of the irrigation development which ultimately evolves. (Appendix A.) These respective gross revenue changes are expected to be as follows: ($ 1985/acre)

	LNID	SMRID
Irrigation	$316	$369
Dryland	39	29
Difference	$277	$340

These estimates, in conjunction with the cost-of-production estimates from Section 3.5 preceding, then suggest that the *incremental* net income difference per acre between irrigation and dryland would be approximately:[1]

	LNID	SMRID
Irrigation	$150	$180
Dryland	20	15
Difference	$130	$165

4.2.2 Livestock

As an integral part of both irrigated and dryland crop production, an estimate of the incremental revenue from anticipated increases in livestock production in the region is also required.

In the *'78 Economic Study*, this was approximated by constructing a regional input-output matrix which quantified the structural linkages between various agricultural commodities with and without irrigation. The data base employed at that time, however, was relatively weak.

The basic data for this report has been extracted from the *1981 Census of Agriculture*. The methodological procedure is the following:

1. Estimate the gross revenue per acre from livestock production for both irrigation and dryland in the regions in question: ($ 1985/acre)

	LNID	SMRID
Irrigation	238.48	103.20
Dryland	17.41	12.70

[1]Appendix Tables A-1 and A-6.

2. Assume the net value-added (income) per acre from livestock production is 28 percent of gross revenue[1] and then calculate the net difference between irrigation and dryland:

	LNID	SMRID
Irrigation	$66.77	$28.90
Dryland	4.87	3.56
Difference	$61.90	$25.34

These differences are incremental income gains attributable to irrigation.

4.2.3 Crop-Livestock Totals

From Sections 4.2.1 and 4.2.2 a projected aggregate direct incremental crop-livestock income change can then be calculated: ($ 1985/acre)

	LNID	SMRID
Crops	$130	$165
Livestock	62	25
TOTAL	$192	$190

Or, for subsequent analytical simplicity (Section V), say $190/acre irrespective of where the irrigation development ultimately takes place.

This 1985/86 estimate (in $1985) is about 57 percent *higher* than the comparable value utilized in the *'78 Economic Study* (in $ 1977). This can generally be traced to inflationary trends and changing agricultural practices during 1978-85. In addition, however, the much better data base available to researchers in 1985/86 suggests that the incremental value-added attributed to irrigation in 1978 was probably biased downward.[2]

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[1]This is identical to the gross margin assumed in the *'78 Economic Study*. The rationale for this margin is provided in the original study.

[2]This became apparent as early as 1982 when a very comprehensive analysis of the economics of irrigation in Southern Alberta revealed (in $ 1982) that the incremental value-added which could be attributed to irrigation was probably as much as $230 to $299 per acre for the LNID and SMRID-E respectively. These estimates are 17-24 percent *higher* than our current 1985/86 estimates. See: Strong-Hall & Assoc., *South Saskatchewan River Basin Planning Program: Evaluation Methodologies, Part II*, Alberta Environment, Calgary, June 1983.

4.3 Local Construction Expenditures

Short-term benefits also accrue to the region through the payment of salaries and wages to local construction personnel, plus the purchase of some local construction materials for the proposed project.

To calculate these benefits we have employed a methodology which in this case is identical to that used in the original *'78 Economic Study* where it was estimated that:

- Disposable income will represent about 75 percent of total regional labor construction costs and perhaps three-quarters of this disposable income will be spent within the study area.
- About 10 percent of total capital costs (less labor) will represent materials purchased within the study area, while the net value-added associated with these materials will be about 25 percent.

In addition, the respective material-labor expenditure ratios are estimated to be approximately as follows:[1]

	Material	Labor
Oldman River Dam	60%	40%
Other Capital Expenditures	80%	20%

With these data and the expenditure patterns already detailed (Sections 3.2 to 3.4), an estimate of the direct benefit of local construction expenditures to the region can be generated. This is expected to amount to about $77M during Years 1-5; perhaps another $12M during Years 6-19.

[1]Regarding the Oldman River Dam, these estimates are generally consistent with the expectation that each $150,000 spent on the dam would generate about one person-year of work. This material/labor expenditure ratio is the same as that employed in the *'78 Economic Study*.

4.4 Indirect "Spin-Offs"

To quantify the indirect net benefits of project implementation inter-industry "multipliers" are employed. A detailed discussion of inter-industry "multipliers" can be found in the *'78 Economic Study*, Appendix L.

For the purposes of this present study, however, we have deviated from the *'78 Economic Study* and relied exclusively on recent (and highly regarded) multipliers calculated by Alberta Treasury.[1]

The multipliers in question are total ratio-form multipliers, with leakages,[2] which are directly applicable to the value-added estimates calculated in Sections 4.2 and 4.3 preceding. The specific multipliers employed are the following:[3]

Industry	Multiplier for G.D.P. at Factor Cost
Construction	2.318
Agriculture	1.868

That is to say, at a provincial level, the indirect spin-off of incomes generated from new construction should be about 132 percent as large as the direct income generated by the project while for agriculture this percentage would be about 87 percent. (The comparable estimates in the original *'78 Economic Study* were 2.28 and 2.20 for construction and agriculture respectively.)

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[1] Alberta Treasury/Bureau of Statistics, *Economic Multipliers for Alberta Industries and Commodities*, Edmonton, March 1984.

[2] "Leakages" are expenditures outside the province. Excluding leakages from the analysis inflates the multipliers accordingly, i.e., the higher the leakages, the lower the provincial multiplier in question.

[3] Alberta Treasury, *op. cit.*, Table 4, p. 22.

At the same time, to generate the appropriate regional multipliers we have still relied upon the *'78 Economic Study* to establish the *ratio* between the respective regional and provincial multipliers.[1] Thus, our revised regional multiplier estimates are now:

Construction: .91 x 2.318 = 2.11
Agriculture: .68 x 1.868 = 1.27

(The comparable estimates in the original *'78 Economic Study* were 2.08 and 1.50 for construction and agriculture respectively.)

The revised estimates are employed in the calculation of the updated regional and provincial benefit-cost ratios presented in Section V immediately following.

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[1]MAA, *op. cit.*, Appendix L.

V. BENEFIT-COST RATIOS

5.1 Introduction

The purpose of this section is to compare the relative magnitude of the respective economic costs and benefits enumerated in Sections III and IV above by employing the methodology detailed in preceding Section II.

The specific regional and provincial benefit-cost formula employed are identical to that used in the *'78 Economic Study*, namely:

$$\text{Regional B/C} = \frac{(GDB - AC) + (GIB - GIC)}{TPC} = \frac{NDB + NIB}{TPC} \qquad (1)$$

where: NDB = net direct benefits,
NIB = net indirect benefits (region),
GDB = gross direct benefits,
AC = associated costs,
GIB = gross indirect benefits (region),
GIC = gross indirect costs (region), and
TPC = total project costs.

$$\text{Provincial B/C} = \frac{(GDB - AC) + (GIB - GIC)}{TPC} = \frac{NDB + NIB}{TPC} \qquad (2)$$

which is identical to (1) above except that in this case:

NIB = net indirect benefits (provincial),
GIB = gross indirect benefits (provincial), and
GIC = gross indirect costs (provincial).

In addition, each B/C ratio has its counterpart Net Present Value = B-C. That is, the numerator *minus* the denominator.

5.2 Empirical Results

The discounted cash flow analysis conducted using formula (1) and (2) above generated the empirical results summarized in accompanying Table 5.1.

The original (1978) regional benefit-cost ratio was 2.2, the revised estimate is 1.64. The original provincial benefit-cost ratio was 3.1; this has now declined to 2.17.

Thus, despite numerous changes in both anticipated costs and projected benefits during 1979-1985 (in nominal dollars), the real change (in constant dollars) appears to have been much less pronounced. Although the revised estimates do indicate that there was a real "cost-price squeeze" during 1979-1985 (and, hence, a modest decline in the respective B/C ratios) the net effect was not serious enough to jeopardize the economic feasibility of the proposed Oldman River Dam.

Using this decision-making criteria, therefore, the principal policy implication is the same as in 1978: the Oldman River Dam is (still) an economically feasible public investment opportunity.

Table 5.1

ECONOMIC BENEFIT-COST RATIOS
FOR THE PROPOSED OLDMAN RIVER DAM, 1985-86*

Criteria	Benefit-Cost Ratio	Net Present Value	
		$M 1985	$M 1977
Regional	1.64 (2.2)	231.1	(193.7)
Provincial	2.17 (3.1)	435.8	(345.8)

*Comparable values from the *'78 Economic Study* ($ 1977) indicated in brackets.

5.3 Final Comments

The benefit-cost ratios calculated in this report represent our best *point estimates* of the ratios in question at this point in time. Nevertheless, it is readily acknowledged that virtually all benefit-cost analyses are *indicative* rather than *definitive*.

A 20 percent error in the respective benefit-cost ratios is not inconceivable.[1] Yet in this instance, even if we allow for a 20 percent downside error, the principal conclusion of the present study would remain unaltered:

Criteria	Minimum (-20%)	Best Estimate	Maximum (+20%)
Regional B/C Ratio	1.31	1.64	1.97
Provincial B/C Ratio	1.74	2.17	2.60

We would still conclude that the Oldman River Dam is an economically feasible public investment opportunity.

Indeed, it is our professional judgement that the benefit-cost estimates generated in the foregoing calculations already reflect a *downward bias* because a number of other benefits have not been incorporated into the analysis. These include:

- Potential net benefits to municipal water users of perhaps $343,000 per annum.[2]
- Potential net benefits because of reduced periodic flood damage, estimated to average $68,000 per annum.[2]
- Potential net benefits for stockwatering, estimated at about $27,000 per annum.

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[1]United Nations, *Guide to Practical Project Appraisal*, UNIDO, Vienna/N.Y., 1978.

[2]The 1978 estimate x the Consumer Price Index.

- No regional benefits have been attributed to annual operation and maintenance expenditures related to the dam and delivery system totalling approximately $1 M yearly.
- Water-based recreational opportunities at the reservoir and downstream.
- Improved fish habitat downstream of the reservoir due to higher minimum flows.
- Potential net benefits to local industry and/or hydro-electric power generation.

All of these considerations would tend to further improve the economic benefit-cost ratios estimated immediately preceding.

In addition, the growing "water crisis" in Southern Alberta during 1979-85 would most likely abbreviate the time originally considered necessary to develop the required on-farm irrigation capabilities. This study, paralleling the *'78 Economic Study*, estimated that it would take 18 years. More rapid irrigation development in the region would also inflate the benefit-cost ratios reported in Section 5.2 above.

Finally, it is suggested that the potentially irrigable acreage which could be served by the proposed Oldman River Dam might well exceed the 173,050 acre maximum used in both the *'78 Economic Study* and the simulations conducted in Section 5.2 preceding.[1] This consideration would also increase the benefit-cost estimates in this report.

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[1]About 195,000 acres were originally identified as the acreage which could be irrigated from the Oldman River Dam in the *'78 Economic Study*. However, this was then deflated to 173,050 acres to account for an historical "use-factor" in the LNID and SMRID-E. In 1985/86, this is probably no longer valid. More recent simulations by Alberta Environment (South Saskatchewan River Basin Planning Program) suggest that the potential physical maximum in this regard is 202,500 (not 173,050) acres of irrigation.

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14. Van Deurzen, A.G.N. and A.L. Birch, *Irrigation Water Requirements in the South Saskatchewan River Basin: Economic Component*, Alberta Agriculture, Lethbridge, February 1983.

15. World Bank, *Price Prospects for Major Primary Commodities* (five volumes), Washington, July, 1984.

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*Referred to as the *'73 Economic Study* in the body of this report.

APPENDIX

APPENDIX A

ESTIMATED NET BENEFITS OF IRRIGATED CROP PRODUCTION

The purpose of this Appendix is to provide the reader with the logic and background data required to estimate the change in net revenue (or net value-added) expected with irrigation versus existing dryland.

A.1 Accounting Framework

The net income of farm operators from farm production is a mixture of rent from the use of land, labor income from self-employment, property income from the buildings and machinery, and a return to entrepreneurship and risk-taking.

This is approximated here by calculating the net value added, as illustrated in accompanying Figure A-1.

A "with" and "without" analysis is then employed. That is:

	Benefits	Costs	Difference
With Project (Irrigation)	R	C	I
Without Project (Dryland)	R'	C'	I'
	R"	C"	I"

where R, C and I are gross revenue, costs, and income (or value-added) respectively.

The basic assumption is that the *real net incremental* revenue change over time will remain constant. Or, in other words (for both irrigation and dryland):

> Any real gross revenue increase (or real unit cost decrease) will be exactly offset by a real unit cost increase (or real gross revenue decrease) or vice versa via technological change, better management, economies of scale, crop mix changes, etc..

Figure A-1

CALCULATION OF THE PROFITABILITY OF AN AGRICULTURAL UNDERTAKING TO PRIMARY AGRICULTURE

Sales + produce for human consumption on the farm + rental of dwelling ± changes in stocks)
less:
Purchase of goods and services (including irrigation water)
gives:

Gross value added (at market prices, i.e., received or expended by the farmer)*
less:
Depreciation
gives:

Net value added
less:
Indirect taxes and taxes on capital (land tax)
gives:

Farming income
less:
Wages, rent, interest (real)
gives:

Family income (cash + produce consumed on the farm)
less:
Notional remuneration of farmer and family workers
gives:

Farm profits (return on family's own funds)**
less:
Notional interest and rent (where the farm belongs to family)
gives:

Net product from production
(rarely used)

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*Actual receipts or expenditures at farm level.

**In industrial accounting also called profit after tax.

Source: Bergmann, H., and J.M. Boussard, *Guide to the Economic Evaluation of Irrigation Projects*, revised, OECD, Paris, 1976, p. 37.

This is illustrated in accompanying Figure A-2.

The final analysis focuses on:

$$R'' - C'' = I - I' = I''$$

as discussed in greater detail in the text.

A-2 Regional Considerations

The exact location of all new irrigation that would accompany implementation of the proposed Oldman River Dam cannot be accurately predicted. Nevertheless, considerable expansion in the LNID and SMRID is expected and, thus, for simplicity, these two Irrigation Districts have been taken as representative of changes in agricultural productivity for wherever the irrigation development ultimately takes place.

The SMRID and LNID are largely located in Agro-climatic Zones A1 and A2 (Figure A-3) while their counterpart drylands are represented by Census Division 1 and 2 respectively (Figure A-4).

Figure A-2

PROJECTED SCENARIO ASSUMING A CONSTANT INCREMENTAL MARGIN I-I'= I" ($ Constant)

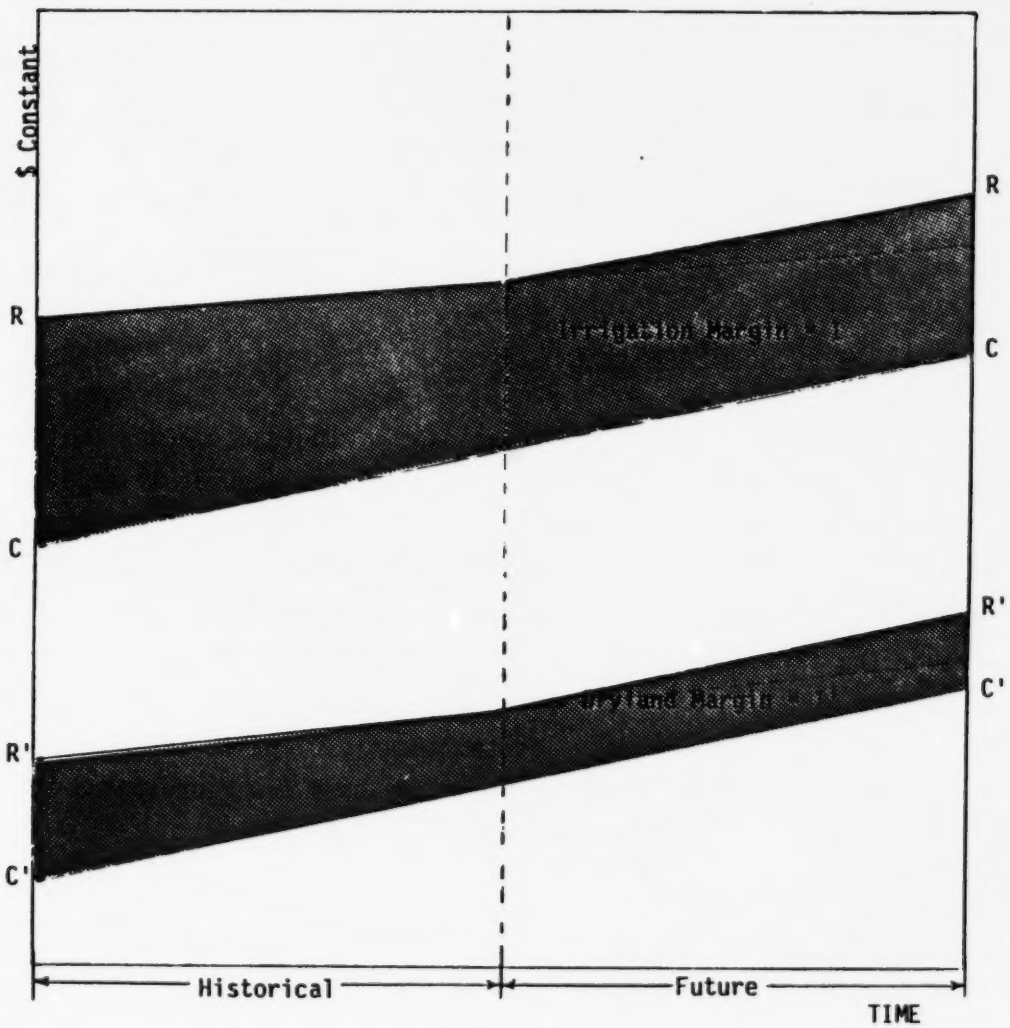
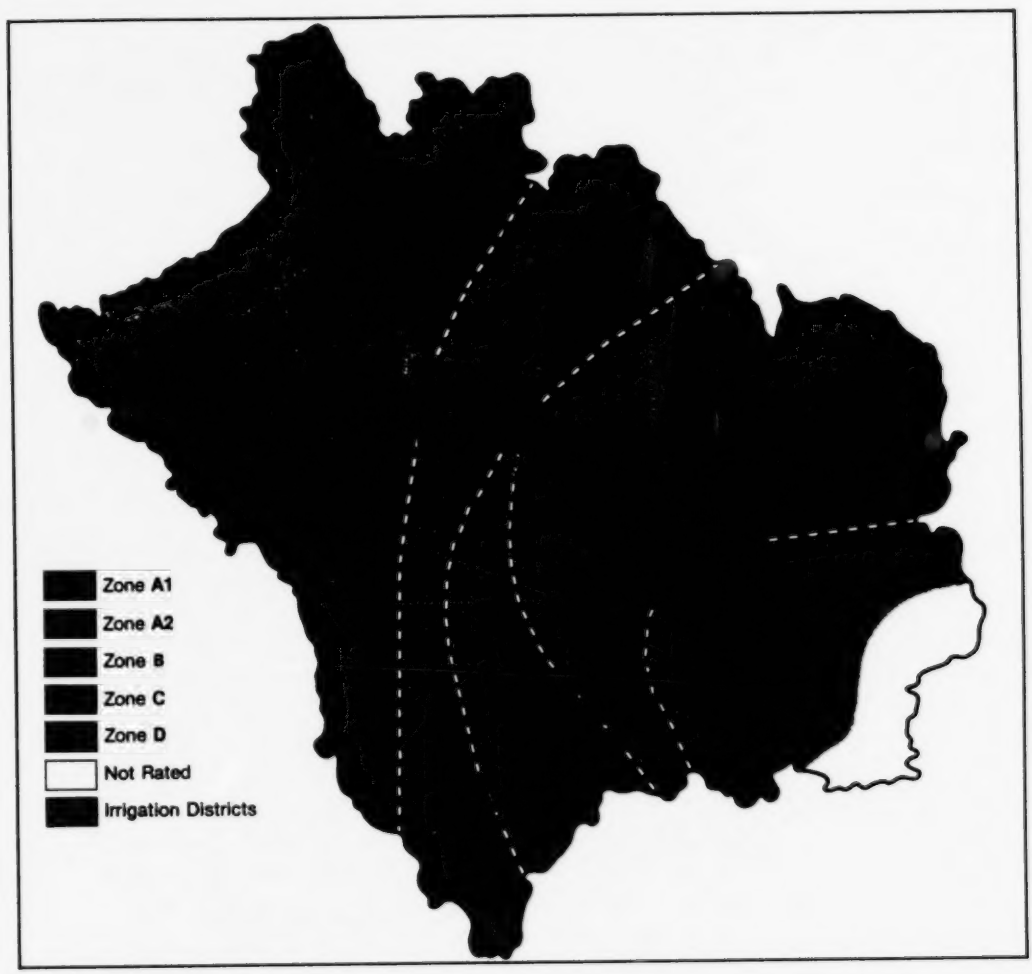


Figure A-3

IRRIGATION DISTRICTS IN RELATION TO AGRO-CLIMATIC ZONES



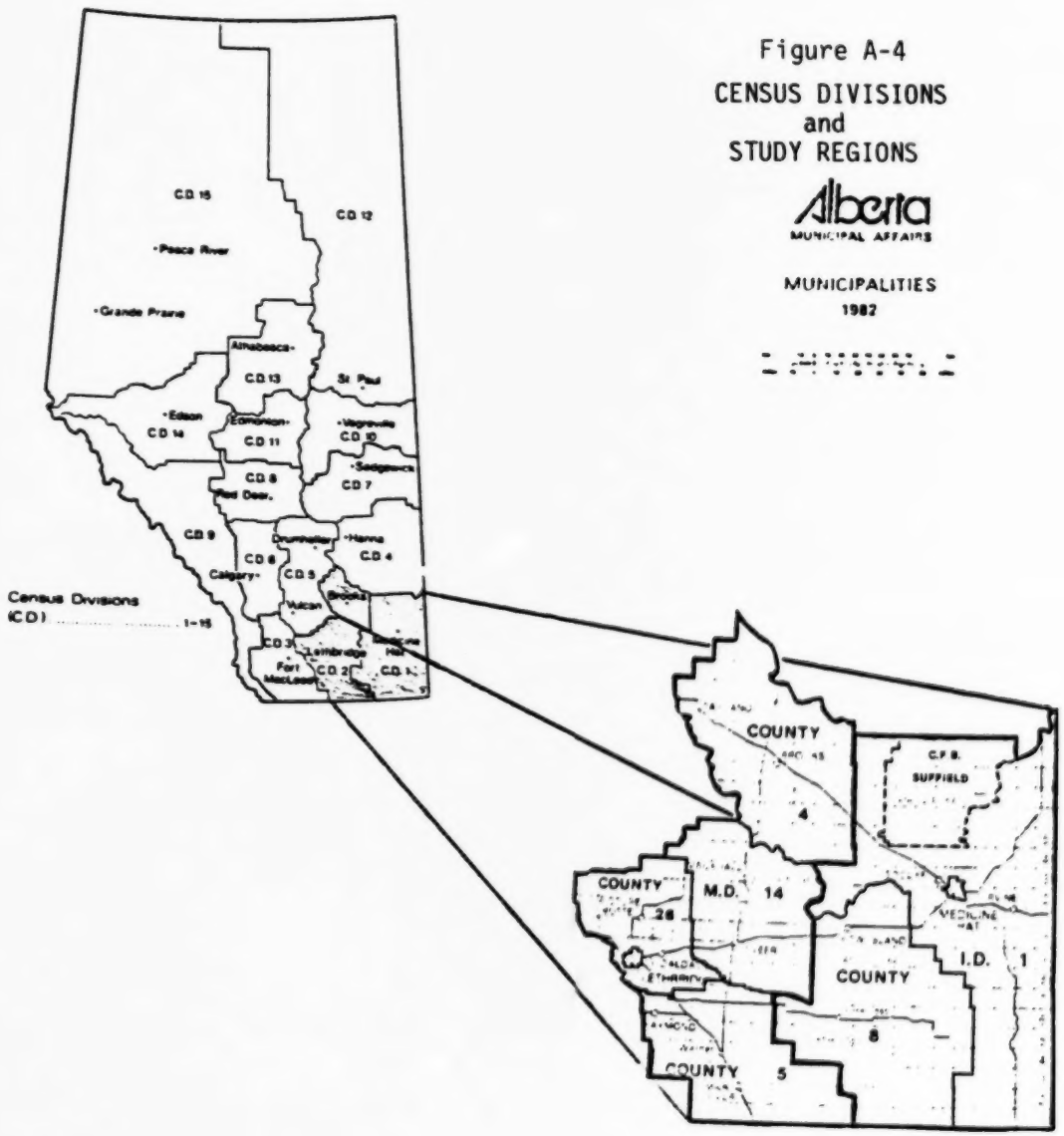
Source: Alberta Environment, South Saskatchewan River Basin Planning Program: Summary Report, Calgary, July 1984.

Figure A-4

CENSUS DIVISIONS
and
STUDY REGIONS

Alberta
MUNICIPAL AFFAIRS

MUNICIPALITIES
1982



A.3 Empirical Estimates

The resulting empirical estimates are provided in Tables A-1 through A-10 following:

Lethbridge Northern Irrigation District

A-1 Summary
A-2/A-3 Irrigation
A-4/A-5 Dryland

St. Mary River Irrigation District

A-6 Summary
A-7/A-8 Irrigation
A-9/A-10 Dryland

The accompanying footnotes should be consulted to clarify procedural questions and secondary data sources.

Table A-1

SUMMARY CALCULATION OF THE EXPECTED CHANGE
IN ANNUAL NET FARM INCOME WITH IRRIGATED CROP PRODUCTION
(per acre)

Lethbridge Northern Irrigation District Area

	Gross Revenue	Production Costs	Net Income
Irrigated Crops	316	166	150
Dryland Crops	39	19	20
Difference	277	147	$130

Source: See accompanying Tables A-2 through A-5.

Table A-2

SIMULATED CROP MIX, YIELD, UNIT PRICE, AND GROSS REVENUE PER 1,000 ACRES OF IRRIGATED LAND

Lethbridge Northern Irrigation District

Land Use	Area [a]	Yield [b]	Price [c]	Revenue
Wheat	324	70	4.68	106,142
Oats	-	120	1.62	-
Barley	209	96	2.61	52,367
Corn	-	200	3.63	-
Canola	n.a.	40	7.46	-
Flax	12	33	8.73	3,457
Other Oilseeds	25	42	7.78	8,169
Tame Hay/Alfalfa	190	3.0	62.11	35,403
Corn Silage	n.a.	5.7	100.70	-
Other Fodder	147	4.1	87.51	52,742
Potatoes	3	19.6	119.07	7,001
Sugar Beets	33	21.9	48.41	34,986
Dry Field Peas	6	1.1	258.76	1,708
Dry Field Beans	2	0.7	337.52	473
Vegetables	8	-	-	11,427 [d]
Improved Pasture	35	5.5 AUM	11.40	2,195
Summerfallow	6	-	-	-
TOTAL	1,000			$316,070
Per Acre				$316
Per Hectare				$781

[a] Based on actual data for 1984, as reported by LNID ditchriders and compiled by Alberta Agriculture/Lethbridge. Actual area irrigated in 1984 = 106,086 acres.

[b] Yields generally taken from: Alberta Agriculture, *Irrigation Water Requirements in the South Saskatchewan River Basin: Economic Component*, Resource Economics Branch, Edmonton, February 1983. (Agroclimatic Zone A2.) The yields for Dry Field Peas and Dry Field Beans are based on data found in: Alberta Agriculture, *Your Crop Choices*, Lethbridge, various years. All yields based on a water application rate of 36.6 cm (14.4"). Grain and oilseed yields expressed in bushels/acre; all other yields provided in (metric) tonnes per acre. AUM = animal unit month.

[c] Economic prices = average 1972-84 prices, expressed in terms of $1985. Deflated by the Agricultural Product Price Index (Alberta), where September 1985 = 100.0. Corn silage and other fodder prices calculated on the basis of TDN barley equivalents (dry basis). Pasture prices = private grazing rates = 1.53 x public grazing reserve rates for irrigated land.

[d] Estimated to generate the same relative *net* revenue as other "specialty" crops.

Table A-3

COSTS OF PRODUCTION FOR IRRIGATED CROPS, CENSUS DIVISION #2, ALBERTA, 1980/85 (per acre)

Lethbridge Northern Irrigation District

CROP	Seed	Fertilizer	Chemical	Taxes	Insurance	Machinery Operation and Repairs		Interest on Operating Capital	Miscellaneous Overhead		Depreciation		TOTAL
						Fuel	Repairs		Buildings	Other	Buildings	Machinery	
Wheat	13.12	25.29	4.68	1.16	.46	11.70	15.17	5.08	1.41	10.15	4.97	33.50	126.69
Oats	7.22	16.27	4.18	1.16	.54	11.34	14.86	3.88	1.41	9.94	9.70	32.81	113.31
Barley[a/]	8.00	21.98	4.92	1.16	.59	11.81	14.56	4.72	1.41	9.65	6.95	32.15	117.90
Corn	19.94	39.13	25.29	1.16	-	12.76	18.65	9.43	1.41	10.70	2.17	41.18	181.82
Canola	5.90	27.92	6.84	1.16	.56	11.10	14.25	5.59	1.41	9.65	4.33	31.46	120.17
Flax	7.74	21.98	6.99	1.16	.59	11.34	14.10	4.91	1.41	5.97	3.80	31.13	111.12
Other Oilseeds[b/]	3.94	23.74	7.38	1.16	-	11.34	14.10	5.18	1.41	6.49	2.17	31.13	108.04
Tame Hay	13.38	12.53	-	1.16	-	11.10	12.59	2.88	1.41	9.08	2.17	27.80	94.10
Corn Silage	20.47	38.69	25.29	1.16	-	14.06	17.29	9.51	1.41	18.49	2.17	38.18	186.72
Other Fodder	17.94	11.21	3.59	1.16	-	8.86	11.98	2.89	1.41	12.73	2.17	26.45	100.39
Potatoes	121.10	62.21	69.03	1.16	-	53.76	62.48	22.55	1.41	35.04	2.17	137.96	568.87
Sugar Beets	14.83	41.77	40.05	1.16	-	34.97	41.10	14.24	1.41	29.11	2.17	90.75	311.56
Dry Field Peas	25.06	33.20	7.43	1.16	-	12.05	14.86	6.42	1.41	6.99	2.17	32.81	143.56
Dry Field Beans	24.27	16.71	14.71	1.16	-	12.40	15.32	5.33	1.41	8.21	2.17	33.83	135.52
Vegetables[c/]	56.28	60.45	48.42	1.16	-	39.82	52.17	18.12	1.41	29.11	2.17	115.19	424.30
Improved Pasture	4.99	10.55	-	1.16	-	3.66	6.22	1.73	1.41	0.51	2.17	13.73	46.13
Summerfallow	-	-	-	1.16	-	5.31	4.70	.64	1.41	5.68	2.17	10.38	31.45
AVERAGE[d/]	13.90 (14.19)	22.37 (24.91)	7.16 (9.65)	1.16 (1.72)	.30 (.36)	13.12 (24.66)	16.17 (20.34)	5.20 (5.53)	1.41 (1.74)	10.66 (13.21)	4.24 (5.42)	35.70 (43.78)	131.39 (165.51)

[a/] Includes mixed grains, rye and buckwheat.

[b/] Includes soybeans, sunflower, and mustard.

[c/] Includes green peas, sweet (canning corn), green beans, nurseries, sod, and tree fruits.

[d/] A weighted average with respect to the typical crop mix in the LNID. For details, see the accompanying revenue calculations. Estimates for the third quarter of 1985 indicated in brackets; adjusted using the respective Farm Input Price Indices for Western Canada.

Basic Sources: Reconciled from data available from Statistics Canada (Census of Ag., 1981), Alberta Treasury (provincial accounts), and Alberta Agriculture (Ag. Stats. and CRD's).

Table A-4

SIMULATED CROP MIX, YIELD, UNIT PRICE AND GROSS REVENUE
PER 1,000 ACRES OF DRYLAND IN CENSUS DIVISION #2, ALBERTA

Lethbridge Northern Irrigation District Area

Land Use	Area [a]	Yield [b]	Price [c]	Revenue
Wheat	215	25.0	4.68	25,155
Oats	7	69.0	1.62	782
Barley/Other	77	40.9	2.61	8,220
Canola/Other	9	17.9	7.46	1,202
Flax	3	15.0	8.73	393
Tame Hay	14	0.5	62.11	435
Oats/Other Fodder	10	1.0	87.51	875
Other Crops	2			222 [d]
Improved Pasture	64	.81 AUM	9.40	487
Fallow	191		-	-
SUB-TOTAL	592			37,771
Other Improved	15		-	-
TOTAL IMPROVED	607			37,771
UNIMPROVED	393	.26 AUM	9.40	960
TOTAL	1,000			$38,731
Per Acre				$39
Per Hectare				$96

[a] Basic data from: Statistics Canada, *Census of Agriculture, 1981* , Ottawa. Exclusive of irrigated land in the area.

[b] Projected 1985 yields based on a linear trend line for the period 1974-83, net of irrigation. For the basic data, see: Alberta Agriculture, *Agricultural Statistics Yearbook*, Edmonton, various years. Grain and oilseed yields expressed in bushels/acre; all other yields provided in (metric) tonnes per acre. AUM = animal unit month.

[c] Economic prices = average 1972-84 prices, expressed in terms of $1985. Deflated by the Agricultural Product Price Index (Alberta) where September 1985 = 100.0. Corn silage and other fodder prices calculated on the basis of TDN barley equivalents (dry basis). Pasture prices = private grazing rates = 1.53 x public grazing reserve rates.

[d] Revenue estimate derived from the per acre average typical of itemized cultivated crops.

Table A-5

COSTS OF PRODUCTION FOR DRYLAND CROPS, CENSUS DIVISION #2, ALBERTA, 1980/85 (per acre)

Lethbridge Northern Irrigation District Area

CROP	Seed	Fertilizer	Chemical	Crop Insurance	Taxes	Machinery Operation and Repairs		Interest on Operating Capital	Miscellaneous Overhead		Depreciation		TOTAL
						Fuel	Repairs		Buildings	Other	Buildings	Machinery	
Wheat	8.49	4.43	2.55	2.34	.70	3.54	4.21	1.61	.27	1.28	1.31	9.78	40.51
Oats	3.96	3.94	1.96	2.12	.70	3.37	4.34	1.42	.27	1.19	3.89	10.56	37.72
Barley	5.67	5.32	2.30	3.42	.70	3.62	4.55	1.72	.27	1.31	2.56	10.27	41.71
Canola	.97	5.27	3.84	3.28	.70	3.33	4.05	1.91	.27	1.12	1.30	9.59	35.63
Flax	6.31	6.60	5.16	3.46	.70	3.47	4.13	2.32	.27	1.41	1.08	9.98	44.89
Tame Hay	.29	1.34	-	-	.70	2.58	3.37	.60	.27	.58	.41	8.12	18.26
Oat Fodder	3.96	3.41	1.96	-	.70	2.85	2.99	1.25	.27	.92	.41	10.37	29.09
Other Fodder	.38	2.72	1.67	-	.70	2.07	2.70	.99	.27	.60	.41	6.46	18.97
Other Crops	7.57	2.77	2.25	2.38	.70	2.88	3.92	1.21	.27	1.10	.41	9.59	35.05
Improved Pasture	-	.68	-	-	.70	-	-	.10	.27	.07	.41	-	2.23
Summerfallow	-	-	-	-	.70	1.62	2.06	.25	.27	.29	.41	3.62	9.22
AVERAGE [a]	4.08 (4.16)	2.55 (2.84)	1.36 (1.83)	1.37 (1.64)	.70 (1.04)	2.48 (4.66)	3.05 (3.84)	.98 (1.04)	.27 (.33)	.80 (.99)	1.02 (1.30)	6.73 (8.25)	25.39 (31.92)
Per Total Acre [b]													$19
Per Total Hectare													$47

[a] A weighted average with respect to the improved land area in C.D. #2 in 1980-81. For details, see the accompanying revenue calculations. Estimates for the third quarter of 1985 indicated in brackets; adjusted using the respective Farm Input Price Indices for Western Canada.

[b] Based upon the ratio of improved land to total land. (Table A-4).

Basic Sources: Reconciled from data available from Statistics Canada (Census of Agriculture, 1981), Alberta Treasury (provincial accounts), and Alberta Agriculture (Ag. Stats. and CRD's).

Table A-6

SUMMARY CALCULATION OF THE EXPECTED CHANGE
IN ANNUAL NET FARM INCOME WITH IRRIGATED CROP PRODUCTION
(per acre)

St. Mary River Irrigation District Area

	Gross Revenue	Production Costs	Net Income
Irrigated Crops	369	189	180
Dryland Crops	29	14	15
Difference	340	175	$165

Source: See accompanying Tables A-7 through A-10.

Table A-7

SIMULATED CROP MIX, YIELD, UNIT PRICE, AND GROSS REVENUE
PER 1,000 ACRES OF IRRIGATED LAND

St. Mary River Irrigation District

Land Use	Area [a]	Yield [b]	Price [c]	Revenue
Wheat	492	75	4.68	172,692
Oats	7	120	1.62	1,361
Barley	95	96	2.61	23,803
Corn	39	200	3.63	28,314
Canola	n.a.	38	7.46	-
Flax	n.a.	35	8.73	-
Other Oilseeds	111	39	7.78	33,680
Tame Hay/Alfalfa	133	3.2	62.11	26,434
Corn Silage	n.a.	6.4	100.70	-
Other Fodder	n.a.	4.6	87.51	-
Potatoes	10	19.6	119.07	23,338
Sugar Beets	45	21.9	48.41	47,708
Dry Field Peas	12	1.1	258.76	3,416
Dry Field Beans	15	0.9	337.52	4,557
Vegetables	1	-	-	1,424 [d]
Improved Pasture	36	5.5 AUM	11.40	2,257
Summerfallow	4	-	-	-
TOTAL	1,000			368,984
Per Acre				$369
Per Hectare				$912

[a] Based on actual data for 1984, as reported by SMRID ditchriders and compiled by Alberta Agriculture/Lethbridge. Actual area irrigated in 1984 (excluding gardens and building areas) = 299,606 acres.

[b] Yields generally taken from: Alberta Agriculture, *Irrigation Water Requirements in the South Saskatchewan River Basin: Economic Component*, Resource Economics Branch, Edmonton, February 1983. (Agroclimatic Zone A1.) The yields for Dry Field Peas and Dry Field Beans are based on data found in: Alberta Agriculture, *Your Crop Choices*, Lethbridge, various years. All yields based on a water application rate of 36.6 cm (14.4"). Grain and oilseed yields expressed in bushels/acre; all other yields provided in (metric) tonnes per acre. AUM = animal unit month.

[c] Economic prices = average 1972-84 prices, expressed in terms of $1985. Deflated by the Agricultural Product Price Index (Alberta) where September 1985 = 100.0. Corn silage and other fodder prices calculated on the basis of TDN barley equivalents (dry basis). Pasture prices = private grazing rates = 1.53 x public grazing reserve rates for irrigated land.

[d] Estimated to generate the same relative *net* revenue as other "specialty" crops.

Table A-8

COSTS OF PRODUCTION FOR IRRIGATED CROPS, CENSUS DIVISION #1, ALBERTA, 1980/85 (per acre)

St. Mary River Irrigation District

CROP	Seed	Fertilizer	Chemical	Taxes	Insurance	Machinery Operation and Repairs		Interest on Operating Capital	Miscellaneous Overhead		Depreciation		TOTAL
						Fuel	Repairs		Buildings	Other	Buildings	Machinery	
Wheat	13.12	33.93	6.36	1.24	.51	14.98	19.48	5.66	1.44	12.57	5.07	43.01	157.37
Oats	7.22	21.83	5.69	1.24	.60	14.52	19.09	4 30	1.44	12.36	7.78	42.15	138.17
Barley[a/]	8.00	29.49	6.69	1.24	.66	15.12	18.71	5.25	1.44	11.94	6.05	41.31	145.90
Corn	19.94	52.50	34.39	1.24	-	16.33	23.96	10.56	1.44	13.25	2.21	52.90	228.72
Canola	5.90	37.46	9.30	1.24	.63	14.22	18.31	6.24	1.44	11.95	3.88	40.43	151.00
Flax	7.74	29.49	9.51	1.24	.67	14.52	18.11	5.48	1.44	7.38	3.93	39.99	139.50
Other Oilseeds[b/]	3.94	31.86	10.04	1.24	-	14.52	18.11	5.78	1.44	8.03	2.21	39.99	137.16
Tame Hay	13.38	16.81	-	1.24	-	14.22	16.17	3.18	1.44	11.24	2.21	35.70	115.59
Corn Silage	20.47	51.91	34.39	1.24	-	18.00	22.20	10.67	1.44	22.92	2.21	49.02	234.47
Other Fodder	17.94	15.04	4.88	1.24	-	11.34	15.39	-	1.44	n.a.	2.21	33.98	n.a.
Potatoes	121.10	83.48	93.88	1.24	-	68.84	80.26	25.17	1.44	43.47	2.21	177.21	698.30
Sugar Beets	14.83	56.05	54.47	1.24	-	44.78	52.79	15.89	1.44	36.10	2.21	116.56	396.36
Dry Field Peas	25.06	44.55	10.11	1.24	-	15.43	19.09	7.18	1.44	8.65	2.21	42.15	177.11
Dry Field Beans	24.27	22.42	20.00	1.24	-	15.88	19.67	5.97	1.44	10.16	2.21	43.43	166.69
Vegetables[c/]	56.28	81.12	65.85	1.24	-	50.99	67.01	20.26	1.44	36.10	2.21	147.96	530.46
Improved Pasture	4.99	14.16	-	1.24	-	4.69	7.99	1.93	1.44	0.60	2.21	17.64	56.89
Summerfallow	-	-	-	1.24	-	6.80	6.04	.69	1.44	7.01	2.21	13.34	38.77
AVERAGE[d/]	12.87 (13.14)	28.43 (31.66)	8.55 (11.53)	1.24 (1.83)	0.29 (0.35)	15.33 (28.82)	19.10 (24.03)	5.35 (5.69)	1.44 (1.78)	10.72 (13.29)	3.80 (4.85)	42.17 (51.72)	149.29 (188.69)

[a/] Includes mixed grains, rye and buckwheat.

[b/] Includes soybeans, sunflowers, and mustard.

[c/] Includes green peas, sweet (canning corn), green beans, nurseries, sod, and tree fruits.

[d/] A weighted average with respect to the typical crop mix in the SMRID. For details, see the accompanying revenue calculations. Estimates for the third quarter of 1985 indicated in brackets; adjusted using the respective Farm Input Price Indices for Western Canada.

Basic Sources: Reconciled from data available from Statistics Canada (Census of Ag., 1981), Alberta Treasury (provincial accounts), and Alberta Agriculture (Ag. Stats. and CRD's).

Table A-9

SIMULATED CROP MIX, YIELD, UNIT PRICE AND GROSS REVENUE
PER 1,000 ACRES OF DRYLAND IN CENSUS DIVISION #1, ALBERTA

St. Mary River Irrigation District Area

Land Use	Area [a]	Yield [b]	Price [c]	Revenue
Wheat	167	31.5	4.68	24,619
Oats	4	47.7	1.62	309
Barley/Other	18	30.9	2.61	1,452
Canola/Other	1	15.0	7.46	112
Flax	2	19.2	8.73	335
Tame Hay	6	0.2	62.11	75
Oats/Other Fodder	5	0.4	87.51	175
Other Crops	1	-	-	133 [d]
Improved Pasture	45	.63 AUM	9.40	266
Fallow	161		-	-
SUB-TOTAL	410			27,476
Other Improved	5		-	-
TOTAL IMPROVED	415			27,476
UNIMPROVED	585	.21 AUM	9.40	1,155
TOTAL	1,000			$28,631
Per Acre				$29
Per Hectare				$70

[a] Basic data from: Statistics Canada, *Census of Agriculture, 1981*, Ottawa. Exclusive of irrigated land in the area.

[b] Projected 1985 yields based on a linear trend line for the period 1974-83, net of irrigation. For the basic data, see: Alberta Agriculture, *Agricultural Statistics Yearbook*, Edmonton, various years. Grain and oilseed yields expressed in bushels/acre; all other yields provided in (metric) tonnes per acre. AUM = animal unit month.

[c] Economic prices = average 1972-84 prices, expressed in terms of $1985. Deflated by the Agricultural Product Price Index (Alberta) where September 1985 = 100.0. Corn silage and other fodder prices calculated on the basis of TDN barley equivalents (dry basis). Pasture prices = private grazing rates = 1.53 x public grazing reserve rates.

[d] Revenue estimates derived from the per-acre average typical of itemized cultivated crops.

Table A-10

COSTS OF PRODUCTION FOR DRYLAND CROPS, CENSUS DIVISION #1, ALBERTA, 1980/85 (per acre)

St. Mary River Irrigation District Area (East)

CROP	Seed	Fertilizer	Chemical	Crop Insurance	Taxes	Machinery Operation and Repairs		Interest on Operating Capital	Miscellaneous Overhead		Depreciation		TOTAL
						Fuel	Repairs		Buildings	Other	Buildings	Machinery	
Wheat	8.49	1.74	1.90	3.02	.75	4.67	5.62	1.87	.29	1.38	1.35	13.22	44.30
Oats	3.96	1.55	1.46	2.73	.75	4.44	5.79	1.69	.29	1.28	2.98	14.28	41.20
Barley	5.67	2.09	1.71	4.41	.75	4.78	6.07	1.93	.29	1.40	2.18	13.88	45.16
Canola	.97	2.07	2.85	4.22	.75	4.39	5.39	2.03	.29	1.19	1.16	12.96	38.27
Flax	6.31	2.59	3.84	4.45	.75	4.58	5.51	2.48	.29	1.45	1.18	13.49	46.92
Tame Hay	.29	.53	-	-	.75	3.41	4.49	.89	.29	.71	.45	10.98	22.79
Oat Fodder	3.96	1.34	1.46	-	.75	3.76	3.99	1.46	.29	1.01	.45	14.01	32.48
Other Fodder	.38	1.07	1.24	-	.75	2.73	3.60	1.13	.29	.65	.45	8.73	21.02
Other Crops	7.57	1.09	1.67	3.06	.75	3.79	5.22	1.48	.29	1.23	.45	12.96	39.56
Improved Pasture	-	.27	-	-	.75	-	-	.06	.29	.06	.45	-	1.88
Summerfallow	-	-	-	-	.75	2.14	2.75	.48	.29	.38	.45	4.89	12.13
AVERAGE [a]	3.89 (3.97)	.87 (.97)	.91 (1.23)	1.46 (1.75)	.75 (1.11)	3.12 (5.87)	3.84 (4.83)	1.10 (1.17)	.29 (.36)	.82 (1.02)	.89 (1.14)	8.48 (10.40)	26.42 (33.82)
Per Total Acre [b]													$14
Per Total Hectare													$34

[a] A weighted average with respect to the improved land area in C.D. #1 in 1980-81. For details, see the accompanying revenue calculations. Estimates for the third quarter of 1985 indicated in brackets; adjusted using the respective Farm Input Price Indices for Western Canada.

[b] Based upon the ratio of improved land to total land. (Table A-9).

Basic Sources: Reconciled from data available from Statistics Canada (Census of Agriculture, 1981), Alberta Treasury (provincial accounts), and Alberta Agriculture (Ag. Stats. and CRD's).